

# EVALUATION OF THE RESULTS OF SURGICAL TREATMENT OF POSTTRAUMATIC STIFFNESS OF THE ELBOW IN SKELETALLY MATURE PATIENTS

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## ABSTRACT

**Objective:** To evaluate the results from surgical treatment of posttraumatic stiffness of the elbow in skeletally mature patients. **Methods:** Between October 2000 and October 2007, 45 elbows of 45 patients underwent surgical treatment performed by the Shoulder and Elbow Surgery Group, Department of Orthopedics and Traumatology, School of Medical Sciences, Santa Casa de São Paulo. Ten patients were treated arthroscopically and the remainder by open surgery. The minimum follow-up was six months, with a mean of 22 months. Their ages ranged from 17 to 72 years, with a mean of 36 years and three months. Males predominated, accounting for 60% of the cases. The dominant limb was involved in 56.5% of the cases. The clinical evaluation of the results was done by using the criteria of the American Medical Association (AMA), as modified by Bruce; the Mayo Elbow Performance Score (MEPS); and measurements on the gain of flexion-extension arc and the final range of motion. **Results:** According to the AMA criteria, as

modified by Bruce, 42.2% of our results were satisfactory, whereas 77.8% were satisfactory according to MEPS. The mean postoperative flexion-extension arc was 106°, and the main gain in range was 46°. The evaluation of the variables showed that patients with an initial flexion arc greater than 90° achieved a greater final flexion-extension arc, and those with an initial extension less than or equal to 60° gained greater range of motion. **Conclusion:** Surgical treatment of posttraumatic stiffness of the elbow in skeletally mature individuals was shown to be satisfactory according to MEPS, but unsatisfactory according to AMA. We observed that the patients with preoperative flexion greater than 90° evolved with a greater flexion-extension arc after surgical treatment, while those who had contracture with extension less than or equal to 60° gained a greater range of motion.

**Keyword** – Elbow; Contracture; Surgery; Range of Motion, Joint; Treatment Outcome

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## INTRODUCTION

The elbow is a joint with a high propensity to evolve with diminution of range of motion (ROM), both through trauma and through inflammation<sup>(1)</sup>. The complexity of this joint (which is composed of three parts), the close proximity of the joint capsule to the muscles, the frequency of comminuting fractures in this region and even the prolonged immobility used by some orthopedists are factors that predispose towards stiffness<sup>(1-4)</sup>.

The etiology of posttraumatic stiffness of the elbow is multifactorial: joint degeneration, heterotopic ossification, post-fracture joint incongruence and contracture of the periarticular soft tissues are frequent findings<sup>(5)</sup>. According to the conditions of the musculature and the osteoligamentous structures, the causes can be classified into three types: extrinsic, intrinsic and mixed<sup>(6)</sup>. The extrinsic type is when the lesion affects extra-articular structures, and this is found in patients with muscle and/or joint capsule injuries, sequelae from burns, compressive neuropathy and heterotopic ossification. Intrinsic stiffness is caused by changes that affect the joint surface, such as: skewed consolidation following fractures, cartilaginous injuries, intra-articular adhesions, interposition of periarticular tissues and formation of intra-articular bone<sup>(6-8)</sup>. The mixed type is when both intrinsic and extrinsic components are involved, and this is the most frequent type<sup>(9)</sup>.

Morrey *et al*<sup>(10,11)</sup> considered that the minimum functional ROM necessary for carrying out activities of daily living was an arc between 130° of flexion and -30° of extension, with 50° of both pronation and supination, thus totaling a range of 100° both in the sagittal and in the coronal plane. They indicated surgical treatment when the ROM was less than this functional minimum.

Other factors should be taken into consideration in the therapeutic decision-making process, in addition to the ROM, such as each patient's pain levels and individual necessities. Non-operative treatment should be implemented for all patients initially, for a minimum of six months, with the aim of attaining a functional and pain-free movement arc. After this period, physiotherapeutic measures no longer have any notable response, and patients should be released for surgery, except in cases of gross joint deformities, for which surgical release is indicated as soon as the diagnosis has been established<sup>(12,13)</sup>. Surgical treatment can be carried out either arthroscopically or by means of an open approach, according to the type of stiffness and

each patient's characteristics. Arthroscopy is generally limited to cases in which there is only a need to release the joint capsule, provided that there is no associated joint incongruence<sup>(11,14-17)</sup>.

The objective of the present study was to analyze the results obtained through arthroscopic or open surgical release, in skeletally mature patients with posttraumatic elbow stiffness.

## SAMPLE AND METHODS

Between October 2000 and October 2007, 45 patients underwent surgical treatment for posttraumatic elbow stiffness, performed by the Shoulder and Elbow Surgery Group, Department of Orthopedics and Traumatology, School of Medical Sciences, Santa Casa de São Paulo.

All patients with a limitation of more than 30° relating to extension and/or flexion of less than 130° who did not respond satisfactorily to physiotherapeutic treatment over a minimum period of six months were included for surgery, as proposed by Stans *et al*<sup>(13)</sup>. An exception to this was made for patients who presented skewed consolidation of a fracture or inveterate dislocation, which were treated without fulfilling this period (Table 1). The exclusion criteria were other causes of stiffness, such as primary osteoarthritis, rheumatoid arthritis, ossifying myositis, burns, etc.

Twenty-seven patients (60%) were male and 18 (40%) were female. Their mean age at the time of the surgery was 36 years and three months, with a range from 17 to 72 years. The dominant limb was affected in 26 patients (56.5%) (Table 1).

The preoperative assessment consisted of taking a detailed anamnesis, performing general physical and orthopedic examinations and producing simple radiographs in anteroposterior (AP) and lateral views, along with lateral views at maximum flexion and extension (Figures 1A and 1B), with the aim of identifying possible bone block points. Other imaging examinations, such as computed tomography and magnetic resonance (Figures 1C and 1D), were performed according to the needs of each case.

The time elapsed between the initial injury and the surgical treatment for stiffness ranged between six months and 32 years, with a mean of two years. Twenty-five patients (55.6%) had undergone previous operations to treat the initial traumatic injury (Table 1).

The main complain was in relation to the limitation on movement. Four patients (8.9%) presented associ-

**Table 1** – Epidemiological data on the patients with posttraumatic elbow stiffness.

No.	Initials	Age	Sex	Dom	Initial injury	Initial management		Preoperative complaint			Stiffness classification			ROM
						Con	Surg	Pain	Deformity	Ulnar paresthesia	E	I	Mi	
1	AAJR	28	M		Firearm wound to elbow	+		+					+	(110, –60)
2	TMCN	39	F		Radial head fracture		+						+	(90, –40)
3	LRO	63	F		Inveterate fracture-dislocation; GII coronoid fracture	+							+	(50, –35)
4	FSP	72	M	+	Exposed dislocation		+		+				+	(90, –90)
5	LFA	47	F		Supracondylar fracture		+		+				+	(90, –20)
6	FRB	39	M		Radial head fracture	+							+	(130, –100)
7	EKS	29	M	+	Radial head fracture-dislocation	+							+	(100, –45)
8	VNS	22	F		Supracondylar fracture	+					+			(130, –90)
9	DSR	63	F	+	Supracondylar fracture		+				+			(120, –40)
10	LF	32	M	+	Radial head fracture-dislocation		+						+	(120, –50)
11	LRP	43	M	+	Radial head fracture	+							+	(120, –30)
12	RGP	17	M	+	Exposed supracondylar fracture		+						+	(120, –35)
13	EA WG	54	F		Supracondylar fracture		+		+				+	(100, –80)
14	NEA	55	F	+	Medial condylar fracture		+						+	(110, –30)
15	JEAP	35	F		Supracondylar fracture		+		+				+	(90, –30)
16	RAS	17	M		Supracondylar fracture		+				+			(130, –60)
17	WLSA	30	M		Exposed olecranon fracture		+						+	(100, –45)
18	JSN	19	F	+	Radial head fracture	+							+	(110, –50)
19	DGS	67	F	+	Trochlear and capitellar fracture		+						+	(90, –10)
20	JJS	39	M	+	Fracture of proximal third of forearm + neurovascular lesion		+						+	(100, –50)
21	BASS	41	M	+	Supracondylar fracture	+				+	+			(110, 0)
22	EGR	41	F		Exposed supracondylar fracture		+						+	(90, –80)
23	RCSS	44	M	+	Exposed supracondylar fracture		+						+	(90, –30)
24	TAC	47	M	+	Supracondylar fracture + fracture of proximal forearm bones		+	+					+	(110, –50)
25	JHP	48	M		Supracondylar fracture		+						+	(100, –10)
26	DGCS	34	F		Dislocation	+					+			(120, –40)
27	PCA	32	F	+	Radial head fracture	+							+	(100, –40)
28	VMG	22	F	+	Dislocation	+					+			(95, –40)
29	RRRC	33	M	+	Radial head fracture-dislocation	+							+	(100, –30)
30	LM	18	M	+	Medial epicondylar fracture-dislocation	+				+	+			(130, –40)
31	RFA	29	M		Radial head fracture	+							+	(100, –100)
32	LAE	51	M	+	Radial head fracture-dislocation		+		+				+	(110, –30)
33	GTD	19	M	+	Exposed olecranon fracture		+						+	(100, –30)
34	ASO	29	M		Chondral lesion; medial epicondylar avulsion fracture	+		+				+		(120, –30)
35	GMP	37	M	+	Supracondylar fracture		+			+			+	(120, –30)
36	LLBP	33	F		Capitellar fracture		+						+	(90, –90)
37	VCDS	24	M	+	Dislocation	+					+			(120, –90)
38	JCS	32	M	+	Monteggia fracture	+			+	+			+	(110, –20)
39	MMB	37	M	+	Dislocation	+					+			(120, –80)
40	LCS	39	M	+	Radial head and coronoid fracture	+							+	(110, –60)
41	PCM	33	F	+	Radial head fracture-dislocation		+	+					+	(90, –80)
42	IM	23	M	+	Exposed supracondylar fracture		+						+	(130, –80)
43	ADCM	42	F		Radial head + ulnar fracture		+						+	(130, –65)
44	LSF	33	F		Lateral condylar fracture		+						+	(120, –40)
45	EFDJ	31	M		Dislocation	+				+			+	(120, –30)
Total				26		20	25	4	6	5	9	1	35	

Source: SAME DOT-ISCMS.

Legend: No.: number, Dom: dominance, ROM: range of motion (flexion-extension), Con: conservative, Surg: surgical, E: extrinsic, I: intrinsic, Mi: mixed, M: male, F: female.

ated pain and six (13.3%) complained of deformity. In five cases (11.1%), there were symptoms relating to the ulnar nerve (Table 1).

The ROM of both flexion-extension and pronation-supination, for both elbows, was measured using a standard goniometer. The flexion-extension arc was also evaluated radiographically in lateral view, at maximum flexion and extension, at the following times: before the operation, immediately after the operation (while still under the effects of anesthesia, which consisted of brachial plexus block) and at the outpatient return visits (Figures 1E and 1F).

The diagnosis for the initial trauma varied, and the ones of greatest incidence were as follows: 13 cases (28.9%) of supraintercondylar fracture, six (13.3%) of dislocation without fracture, six (13.3%) of radial head fracture and five (11.1%) of radial head fracture-dislocation. With regard to the etiology of the stiffness, one case (2.2%) was classified as intrinsic, nine (20%) as extrinsic and 35 (77.8%) as mixed (Table 1).

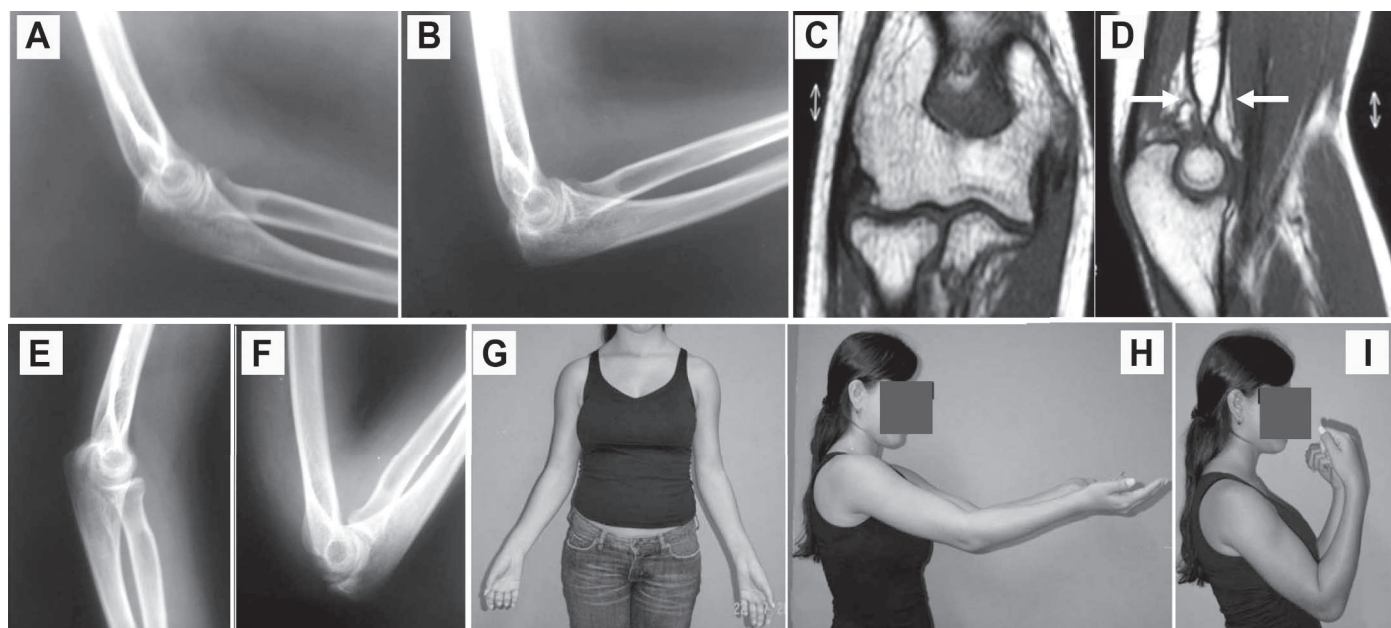
Among the cases with an open approach, a posterior access was used in 26 (57.8%); lateral in five (11.1%); lateral combined with medial in four (8.9%) to perform neurolysis and anteriorization of the ulnar; and medial alone in one (case 45), in which only medial ossification was present. In 10 patients (22.2%), the surgical proce-

dures were performed arthroscopically, in association with a medial access in cases in which the ulnar nerve was explored (Table 2).

All the patients underwent anterior and posterior capsulectomy, independent of the type of stiffness and the access route used. Other procedures were used in association, as required, such as: removal of synthesis material in 14 cases (31.1%); excision of the radial head in nine (20%); resection of the tip of the olecranon in eight (17.8%); resection of ossification in five (11.1%) and anteriorization of the ulnar nerve in 11 (24.4%). The latter was anteriorized when there was a preoperative complaint of paresthesia (five cases; 11.1%) and when tension in the nerve following joint release was noted (six cases; 13.3%) (Table 2).

Postoperative analgesia was achieved by administration of intravenous and oral analgesics. Physiotherapy was started on the first postoperative day, with passive mobilization. Active mobilization was started in the fourth week and load-bearing exercises only after the eighth week.

The patients were reevaluated in accordance with functional assessment protocols proposed by Morrey *et al*<sup>(11)</sup> (MEPS) and using the AMA criteria, as modified by Bruce *et al*<sup>(18)</sup> (Table 2). The ROM was recorded at all the postoperative consultations through the use of a



**Figure 1** – Images relating to patient number 28, with satisfactory result. A and B – Preoperative radiographic images of the right elbow, in lateral view, at maximum extension ( $-40^{\circ}$ ) and flexion ( $95^{\circ}$ ). C and D – Magnetic resonance image showing joint surface in good condition and anterior and posterior capsule thickening (white arrows) in the right elbow. E and F – Postoperative radiographic images, in lateral view, at maximum extension ( $-30^{\circ}$ ) and flexion ( $130^{\circ}$ ). G, H and I – Frontal and lateral images at maximum extension and flexion, at the time of the last consultation.

**Table 2** – Procedures performed for surgical treatment of posttraumatic elbow stiffness and results.

No.	$\Delta T$ (months)	Access	Ant. ulnar nerve	RSM	Resection			Follow-up (months)	MEPS				AMA				ROM	Complications
					Radial head	Ossification	Tip of olecranon		Ex	G	F	P	Ex	G	F	P		
1	9	p	+					24			+					+	(120, -20)	Paresthesia of ulnar nerve
2	4	l		+				13	+					+			(110, -20)	
3	6	p						27	+					+			(140, -20)	
4	4	l + m						74				+				+	(80, -50)	Dislocated elbow
5	6	p		+				36	+				+				(130, 0)	
6	12	p			+		+	12	+							+	(130, 0)	
7	12	a			+			6		+						+	(130, -35)	
8	121	p					+	43			+					+	(120, -50)	
9	7	p		+				40	+					+			(140, -10)	
10	8	l			+			36		+						+	(135, -25)	
11	8	a			+			30	+					+			(130, 0)	
12	22	p					+	58		+					+		(120, -10)	Neurotmesis of radial nerve
13	5	p		+				38		+				+			(130, -10)	
14	13	p					+	36	+						+		(110, -20)	
15	6	p	+	+				7		+					+		(110, -30)	
16	54	p					+	6	+					+			(140, -20)	
17	17	p		+			+	32	+					+			(130, -15)	
18	15	p			+		+	19			+					+	(100, -15)	
19	12	p		+				38		+					+		(120, 0)	Paresthesia of ulnar nerve
20	13	p		+				16			+					+	(130, -50)	
21	384	a + m	+					36		+						+	(130, 0)	
22	14	p			+	+		11			+					+	(100, -40)	Paresthesia of ulnar nerve
23	12	p						23		+						+	(100, -20)	Paresthesia of ulnar nerve
24	42	p						8			+					+	(110, -10)	
25	16	p		+				10			+					+	(110, -20)	
26	6	a						18	+				+				(140, -10)	
27	8	a			+			18		+						+	(120, -30)	
28	10	a + m	+					17	+					+			(130, -30)	Neurotmesis of radial nerve and axonotmesis of median nerve
29	4	a						30		+					+		(130, -10)	
30	19	a	+					24	+					+			(140, -30)	
31	7	p	+			+		27			+					+	(90, -10)	
32	11	l + m						24	+					+			(130, 0)	
33	6	p		+				23	+				+				(130, -10)	
34	10	a						13		+					+		(140, -35)	
35	14	p	+	+				35			+				+		(140, -5)	Paresthesia of ulnar nerve
36	10	p	+					20		+						+	(100, -10)	
37	5	a						20	+				+				(140, 0)	
38	240	l + m	+		+			14	+				+				(140, 0)	
39	14	l				+		17		+			+				(140, -10)	
40	7	l				+		15	+					+			(130, -20)	



No.	$\Delta T$ (months)	Access	Ant. ulnar nerve	RSM	Resection			Follow-up (months)	MEPS				AMA				ROM	Complications
					Radial head	Ossification	Tip of olecranon		Ex	G	F	P	Ex	G	F	P		
41	4	l + m	+					18		+					+		(130, -10)	
42	34	p		+			+	8	+						+		(120, -40)	
43	7	p		+	+			13		+						+	(120, -50)	
44	18	l		+				12	+				+				(140, -10)	Paresthesia of ulnar nerve
45	7	m	+			+		8	+				+				(150, 0)	
Total			11	14	9	5	8		20	15	9	1	8	11	9	17		

Source: SAME DOT-ISCMS.

Legend: No.: number,  $\Delta T$ : time elapsed between initial injury and stiffness treatment, Ant: anteriorization, RSM: removal of synthesis material, ROM: range of motion (flexion-extension), Ex: excellent, G: good, F: fair, P: poor, p: posterior, l: lateral, m: medial, a: arthroscopy, MEPS: Mayo Elbow Performance Score, AMA: American Medical Association.

goniometer (Figures 1G, 1H and 1I) (Table 1).

In this study, we listed preoperative variables that could indicate better or worse prognosis for the treatment for posttraumatic elbow stiffness. These variables were: age, dominance, sex, time elapsed between the initial injury and treatment for the stiffness, type and treatment for the initial trauma. We subdivided the contractures into four groups, according to the degree of joint mobility (Box 1).

**Box 1.** Contracture groups according to the limitation on ROM.

Group	Degree of joint mobility
I	flexion $\leq 90^\circ$
II	flexion $> 90^\circ$
III	extension $\leq -60^\circ$
IV	extension $> -60^\circ$

These variables were then compared in relation to the final results obtained, with the aim of defining any prognostic factors for the surgical treatment for stiffness.

We used the SPSS software (Statistical Package for the Social Sciences), version 13.0, and applied the Mann-Whitney and Kruskal-Wallis tests to assess whether the variables interfered with the result. The first test was used for two variables (dominance, sex, flexion  $\leq 90^\circ$ , extension  $\leq -60^\circ$  and initial treatment) and the second for more than two (age; time elapsed between the initial injury and the treatment for the stiffness; and type of initial trauma). We used the Wilcoxon signed rank test to evaluate differences between the results obtained on the MEPS and AMA scales, and to investigate differ-

ences between the initial and final flexion, extension and flexion-extension arc. For all the tests, p values  $\leq 0.05$  were taken to be statistically significant.

## RESULTS

The mean postoperative follow-up was for 22 months, with a range from six to 74 months.

The clinical measurement of the mean flexion-extension arc increased from  $60^\circ$  before the operation to  $106^\circ$  at the last assessment. There were statistically significant differences ( $p < 0.001$ ) regarding the improvements in flexion, extension and range of motion.

According to the functional assessment protocol proposed by AMA, as modified by Bruce, eight cases were classified as excellent (17.8%), 11 as good (24.4%), nine as fair (20%) and 17 as poor (37.8%), with a mean of 80.62 points. According to MEPS, 20 cases were classified as excellent (44.5%), 15 as good (33.3%), nine as fair (20%) and one as poor (2.2%), with a mean of 85.11 points. The evaluations using the AMA and MEPS criteria were compared, and it was found that AMA was much more rigorous, both in relation to point distribution (mean of 80.62 versus 85.11 from MEPS) and in relation to the number of satisfactory results (42.2% versus 77.8%), with a statistically significant difference ( $p < 0.001$ ).

Five patients evolved with paresthesia in the ulnar region. There were two cases in which neurological injuries occurred during the surgery: one in an open operation (radial nerve) and the other in an arthroscopic procedure (radial and median nerves). Both of these cases were diagnosed and treated after the procedure.

Most of the variables analyzed before the operation did not show any statistically significant difference that

would indicate that they could be prognostic factors, with the exception of groups II and III (Tables 3 and 4).

**Table 3** – Statistical analysis comparing results from treating elbow stiffness between groups I and II.

	Mean		p-value
	Group I: $\leq 90^\circ$	Group II: $> 90^\circ$	
Flexion-extension arc	86	111°	0.048
Flexion-extension gain	56°	44°	0.408
MEPS	78°	87°	0.24
AMA	74°	82°	0.281

Source: SAME DOT-ISCMS.

Legend – MEPS: Mayo Elbow Performance Score, AMA: American Medical Association.

**Table 4** – Statistical analysis comparing results from treating elbow stiffness between groups III and IV.

	Mean		p-value
	Group III: $\leq -60^\circ$	Group IV: $> -60^\circ$	
Flexion-extension arc	95°	112°	0.126
Flexion-extension gain	64°	37°	0.011
MEPS	79°	88°	0.107
AMA	75°	83°	0.185

Source: SAME DOT-ISCMS.

Legend – MEPS: Mayo Elbow Performance Score, AMA: American Medical Association.

## DISCUSSION

Surgical treatment for elbow stiffness in adults is well established, with good results in most patients. It has been reported that 90% of the patients present gains in ROM and that more than 50% return to a functional range of motion(4,6,12,19). In our series, 53.3% of the patients attained a functional arc and only four patients (8.9%) achieved a gain in flexion-extension of less than 10°; thus, we found results that were similar to the literature.

In agreement with the published studies regarding the cause of the stiffness, we found that the mixed type predominated (84.7%) over the intrinsic and extrinsic types(1,20). Also like in the literature, we found that supraintercondylar fractures of the humerus and radial head fractures predominated as etiological factors for posttraumatic stiffness(3,4,6,21-23).

With regard to treatment type, like in the literature, we predominantly used posterior (57.8%) and lateral (20.0%) access routes. We chose the arthroscopic route in 22.2% of the cases, and these were the ones with less

impairment of the joint, for which only capsule release was indicated(4,7,12,22,24,25).

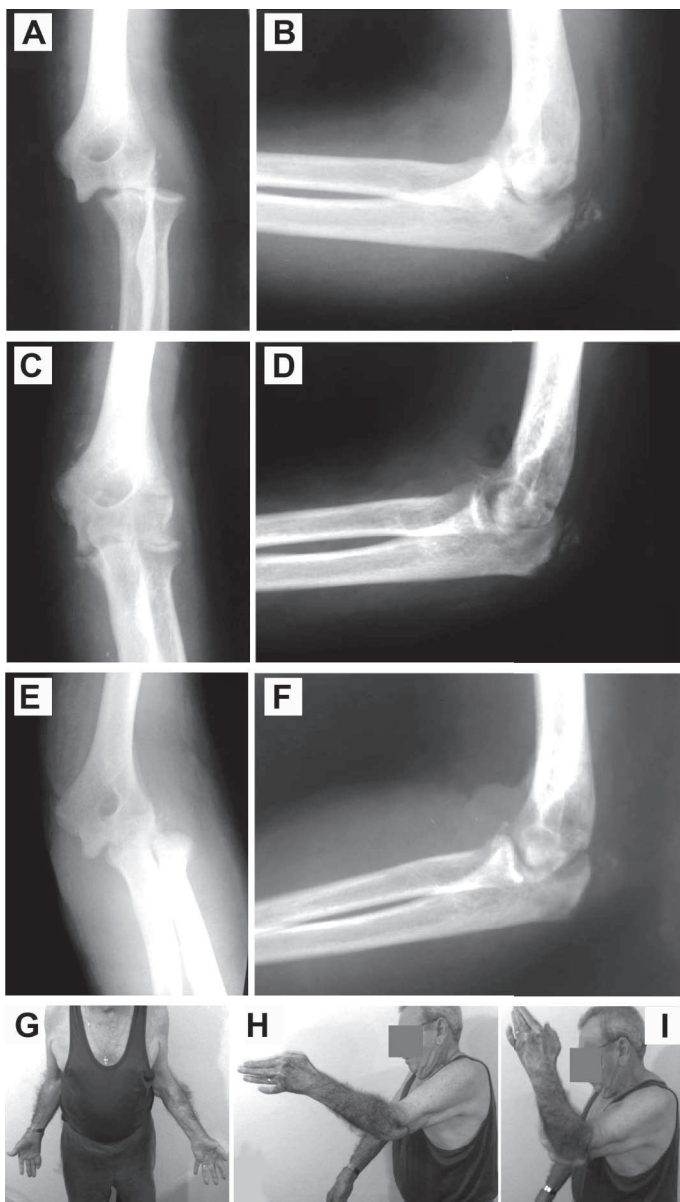
In the present study, we found that there was a mean gain of flexion-extension of 46°. This was within the range of mean gains described in the literature, which go from 40° to 59°(7,12,20-24).

Turchin *et al*^(26) compared five functional assessment systems, including MEPS, and reported that there were great discrepancies between all the methods. They suggested that the disparity resulted from the fact that each method assessed different questions and attributed proportionally different values to the same items evaluated. In our view, the AMA assessment method depicts the result from the stiffness treatment better, since it gives greater importance to the ROM, while MEPS mainly gives value to pain-related factors.

One case had poor results using both methods (case number 4). The initial diagnosis in this case was that this was an inveterate exposed dislocation associated with latent infection. Open reduction was performed, together with capsule release and retensioning of the lateral ligament. During the operation, instability was observed with the elbow in a position of 30° of extension and supination. During the postoperative follow-up, this case evolved with recurrence of the infection and loss of the reduction, and arthrodesis of the elbow was therefore indicated. However, the patient refused to undergo this procedure (Figure 2).

Neurovascular lesions have been described in the literature as complications from surgical treatment for elbow stiffness. Morrey^(12) reported that the three main nerves of the elbow may suffer injury during the operation or during the rehabilitation process, and stated that the ulnar nerve was the one that was most affected, and that such injury could occur in 10% of the cases. Cohen and Hastings^(22) reported that the commonest complication is transitory paresthesia in the ulnar region. They ascribed this to surgical manipulation, edema and fibrosis in the cubital tunnel and tension in the nerve caused by the gain in flexion. The incidence of paresthesia in their study was 13.6%. We found neuropraxia of the ulnar in five patients (11.1%) of our series after the operation to treat the stiffness: of these, three improved without any additional management, while two cases persisted with symptoms even after anteriorization in a new operation.

It has been reported in the literature that the radial nerve and its posterior interosseous branch may be



**Figure 2** – Images relating to patient number 4, with poor result. A and B – Preoperative AP and lateral radiographic images of the left elbow showing lateral dislocation. C and D – Postoperative AP and lateral radiographic images of the left elbow showing reduction of the dislocation. E and F – Radiographic image of the left elbow, in AP and lateral views, showing recurrence of dislocation. G, H and I – Frontal and lateral images of the left elbow at maximum extension and flexion, at the end of the follow-up.

subject to lesions because of excessive compression by spacers, either in the lateral access or in constructing the

anterolateral port during the arthroscopic surgery<sup>(1,27)</sup>. Haapaniemi *et al*<sup>(28)</sup> also reported a case in which there was transection of radial and median nerves during arthroscopic release to treat stiffness. We had two patients with neurological lesions (cases 12 and 30). In case 12, neurotmesis of the radial occurred during open surgery, and grafting using the sural nerve was performed three months later. In case 30, there was axonotmesis of the median and neurotmesis of the radial during arthroscopy, and this case then underwent neurolysis of the median nerve and grafting using the sural nerve in the radial one month later.

We conducted a statistical analysis in which we attempted to identify prognostic factors for greater gain in ROM. We only found that the patients in group III presented greatest gain in ROM, and that the patients in group II presented the greatest final flexion-extension arc, because they possibly had the greatest severity of stiffness. These data could not be compared with the literature, since no other similar study has so far been produced.

The other factors such as age, sex, dominance, time elapsed between injury and treatment, implementation of treatment for the initial trauma, type of lesion and presence of contracture in flexion or extension, did not establish any changes in the prognosis regarding release of the elbow stiffness. Ring *et al*<sup>(24)</sup> also did not find that age, sex, trauma mechanism or initial treatment had any relationship as factors that might change the results on the DASH, MEPS and ASES scales.

## CONCLUSION

We found that the surgical treatment for elbow stiffness in skeletally mature patients promoted an improvement in ROM.

Patients with flexion greater than 90° achieved a greater final flexion-extension arc.

Patients who had contractures at extensions less than or equal to 60° achieved a greater gain in movement.

We observed that the assessment criteria used presented differences. The AMA criteria, as modified by Bruce, were shown to be more rigorous than the MEPS criteria.

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